

ENERGY CONSERVATION MANUAL

for

GOVERNMENT DEPARTMENTS

PREPARED BY

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DEPARTMENT OF PUBLIC WORKS**

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Table of Contents

SECTION I : INTRODUCTION	8
APPLICATION	8
ENERGY SAVINGS CONCEPT	8
MANUAL STRUCTURE	8
MEASUREMENT OF SAVINGS	9
MONITORING PERFORMANCE	9
SECTION II : AWARENESS INFORMATION	11
ELECTRICITY TARIFFS	11
Tariff Selection Considerations	11
Tariff 41 Buildings	11
ENERGY MANAGEMENT	13
Starting Point	13
Implementing Measures	13
ENERGY OFFICER	13
ENERGY USAGE	14
Building Related Considerations	14
Catering Service Related Considerations	15
Building Services Related Considerations	15
Energy Conservation Related Considerations	16
Health and Safety	16
HIDDEN TRAPS	17
Inter Relationships	17
New Building Developments	17
Conserve Water	17
HOUSE KEEPING	17
TERMINOLOGY DEFINITIONS	18
WORKPLACE HEALTH & SAFETY REGULATIONS (APPENDIX I)	18
Space Ventilation	18
Space Temperature	19
Air Movement	20
Humidity	21
SECTION III : OPERATIONAL MANAGEMENT STRATEGIES	23
ACCOUNTABILITY	23
EMPLOYEE INVOLVEMENT	23
HOT LINE	23
MONITORING	23
Historical Records	23
Building Security	23
New Construction Projects	24
NEW FACILITIES	24
Project Energy Brief	24
Technical Guidelines	24
PROJECT DESIGN STAGE	24
DESIGN REVIEWS	25
PROGRAMS	25
SUPPORT MECHANISMS	25
STAFFING	25
SYSTEMS	26

ENERGY CONSERVATION MANUAL for ENTERPRISE BARGAINING AGREEMENT
Core Government Departments

CLEANING ACTIVITIES.....	44
House Keeping Measures	44
Maintenance Measures.....	45
LAUNDRY ACTIVITIES.....	45
House Keeping Measures	45
OFFICE EQUIPMENT USAGE/PURCHASES	46
House Keeping Measures	46
New Equipment Purchases	46
SECTION VI : BUILDING ELEMENTS & INFRA STRUCTURE	49
ALTERNATIVE ENERGY SOURCES.....	49
House Keeping Measures	49
Installation Refurbishments	49
BUILDING STRUCTURE	49
Building Refurbishments	49
Housekeeping Measures	50
Maintenance Measures.....	51
AIR CONDITIONERS (ROOM).....	51
House Keeping Measures	51
Maintenance Measures.....	51
New Equipment Purchases	51
AIR CONDITIONING	51
Installation Refurbishments	51
System Operation	52
Maintenance Measures.....	52
AIR HANDLING SYSTEMS	52
Installation Refurbishments	52
Maintenance Measures.....	53
System Operation.....	53
CHILLED WATER INSTALLATIONS	53
House Keeping Measures	53
Installation Refurbishments	54
Maintenance Measures.....	54
COLD ROOMS	54
House Keeping Measures	54
Installation Refurbishment.....	55
Maintenance Measures.....	55
COMBUSTION EQUIPMENT (BOILERS, INCINERATORS).....	55
Housekeeping Measures	55
Installation Refurbishments	55
Maintenance Measures.....	55
System Operation.....	56
COMPRESSED AIR	56
Housekeeping Measures	56
Installation Refurbishments	56
Maintenance Measures.....	56
CONTROL SYSTEMS	57
Housekeeping Measures	57
Installation Refurbishments	57
Maintenance Measures.....	57
COOLING WATER INSTALLATIONS	58
Installation Refurbishments	58
Maintenance Measures.....	58
EVAPORATIVE COOLING	58
Installation Refurbishments	58
Maintenance Refurbishments.....	59

ENERGY CONSERVATION MANUAL for ENTERPRISE BARGAINING AGREEMENT
Core Government Departments

House Keeping Measures	75
SECTION VII : DIGITAL MICROPROCESSOR	
ENERGY MANAGEMENT SYSTEM.....	77
SOFTWARE REQUIREMENTS SCHEDULE	77
SYSTEM FUNCTIONS SCHEDULE.....	80
OPERATOR TOOLS SCHEDULE	80
BIBLIOGRAPHY	82

SECTION I

INTRODUCTION

SECTION I : INTRODUCTION

APPLICATION

- This manual has been produced for the use by core Departments required to achieve 5% energy savings over a two year period as an integral element of an enterprise bargaining agreement.
- Organisations at various stages of implementation of energy conservation programs can also use this document as a reference aid for energy auditing, installation modification, or staff education activities.

ENERGY SAVINGS CONCEPT

- The concept is to save 5% of the energy costs over the two year period of the enterprise bargaining agreement, compared to a "Business As Usual" approach as if no energy management measures had been adopted. See Fig I below.
- The aim of the concept is to modify employee behaviour to capture savings, and to identify other energy management activities which can achieve further energy savings.

The latter may require capital input from Departments.

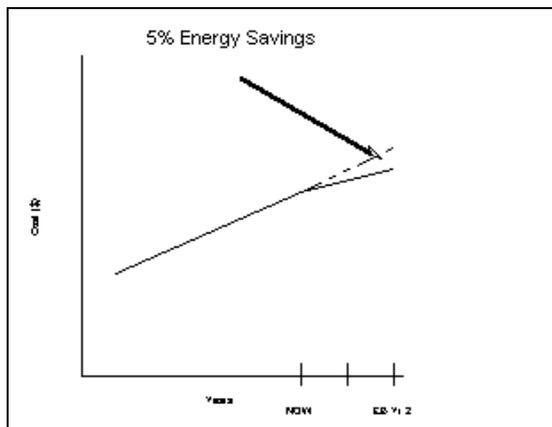


Figure 1

MANUAL STRUCTURE

- The philosophy behind this manual is one which will allow users to introduce energy conservation practices regardless of their position or role within their organisation.
- This manual is structured on a sectional basis to address the requirements with respect to Awareness Training (Section II), Operational Management (Section III), Provision of Accommodation (Section IV), Operational Activities which impact Energy Usage

- (Section V), Building Elements and Associated Infra Structure (Section VI), Digital Micro Processor Energy Management Systems (Section VII).
- Section VII, Digital Micro Processor Energy Management Systems, has been included to assist building maintenance personnel rather than the layperson.
 - This manual provides a "shopping list" of energy conservation related measures. It must be kept in mind that many measures will not apply to a particular building or situation. Manual users should disregard those sections that do not apply to their particular circumstances.

MEASUREMENT OF SAVINGS

- Energy bill comparison from period to period needs to take into consideration the impact that climatic changes or expansion to business operations can have on energy usage. The Integrated Energy Management Centre in Tasmania have developed a package that allows comparison from period to period. A "building signature" is developed that can remove the impact of changes in climatic conditions and operations to allow comparison.
- An alternative approach is to audit operations to measure energy usage, identify those activities which can be influenced by employees and periodically monitor compliance.

MONITORING PERFORMANCE

- Each core Department is responsible for putting in place appropriate mechanisms to monitor the progress being made towards achieving the 5% energy savings target.
- A register of energy consuming assets which includes their energy capacity and usage characteristics should be developed. This register can then be used to identify the purchase of new equipment or the replacement of equipment with higher efficiency units.

SECTION II

AWARENESS INFORMATION

SECTION II : AWARENESS INFORMATION

ELECTRICITY TARIFFS

Tariff Selection Considerations

- Use the most appropriate electricity tariff.
- The cheapest energy source may not necessarily be the cheapest or best one.
- Electricity costs depend on when it is used, and on which tariff it is charged.
- Refer to attached schedule for comparison of tariffs.

Tariff 41 Buildings

- The peak demand may be more easily determined by examining a building's load profile. It gives one a pictorial view of the load variations that may take place on one day in the life of a building.
- Energy intensive functions such as cooking, heavy use of elevators, etc, have a major impact upon the buildings' peak demand profile.
- Energy saving opportunities inherent in night set back, cooling shut down and integrated economiser cycle can do little to reduce demand but can offer significant reduction in consumption energy charges.

SCHEDULE of TARIFF COMPARISONS

Tariff	Applicability	Tariff rate cents/kWh
General Supply Tariff 21	Appropriate for general power and light requirements of organisations which operate 8 hours/day, with little night time or weekend consumption.	10.70-14.0
Off-peak Tariff 31	Water heating or other permanently-connected loads that can operate at night and off-peak periods.	4.18
Controlled Tariff 33	Water heating or other permanently-connected loads for which supply can be interrupted for up to 8 hours/day.	6.00
General Supply Time-of-use Tariff 23	Suitable for organisations which use at least 30% of their consumption at night and weekends, and whose consumption exceeds 1,600 kWh/month (\$230/month)	daytime: 12.95-15.80 night/weekends: 5.46
Demand Tariff 41	Suitable for organisations whose consumption is "spread out" without peak periods, and exceeds 16,000 kWh/month (\$2,000/month)	depends on pattern of energy use. Can be as low as 6.3 cents/kWh under ideal conditions.

ENERGY MANAGEMENT

Starting Point

- The identification and quantification of energy waste streams and their sources is Phase 1 of the total energy management program.
- The starting point is for energy officers to resurrect the previous two years' electricity, oil or gas bills and plot monthly energy consumption on a MJ/m² basis for such areas as desired.
- The following table indicates that the most advantageous fields for energy saving, apart from tariff changes and fuel substitution, are:

Initiative	Typical Payback (Yr)
Time Control	0.4
Minimise Outside Air	0.5
Lighting Control	1.1
Economy Cycle	1.7
House Keeping	1.8
Demand Control	1.9
Other HVAC Control	2.0
Solar Film/Shading	2.1
Lighting Modifications	2.4

Implementing Measures

- Implement simple, low-cost measures first.
- Simple inexpensive measures that achieve modest energy cost savings will instil confidence by management and staff.

ENERGY OFFICER

- The job of energy officer is not necessarily a full-time assignment.
- This duty can normally be assumed by a member of the office staff.
- It is important that the responsibility be focused on one individual who is in a high enough organisational level to accomplish the program without delay.
- Duties for such a position are:
 1. Assume responsibility for co-ordinating all energy conservation functions.
 2. Regularly review the status of the energy conservation program and its

effectiveness.

3. Establish energy conservation procedures and regularly inspect the facility to insure that these procedures are being followed.
4. Observe all phases of operations, including production processes, water treatment, waste treatment, and boiler house, to determine the effects of energy consumption changes of one department on another department.
5. Initiate an energy cost accounting system and monitor its effectiveness.
6. Review energy consumption and cost data and submit a monthly summary report and comments to the general manager.
7. Investigate all ideas proposed for energy reduction, including estimation of capital and operating costs and environmental effects.
8. Prepare capital appropriation requests and issue purchase requisitions for energy conservation jobs.
9. Follow up on work orders for energy conservation jobs.
10. Prepare and conduct a training program for engineers, foremen and others on where and how energy can be saved.
11. Notify general manager of changes or conditions which may affect energy availability or consumption.

ENERGY USAGE

Building Related Considerations

- Energy usage varies considerably from building to building.
- A buildings' energy requirements will vary seasonally, daily and even hourly, because of weather and occupancy influence, cooling, heating and lighting needs.
- For commercial office buildings the Energy Utilisation Indices is usually expressed in the form of an energy utilisation index in units of energy used per square meter of net rentable area per annum.
- In commercial buildings most of the energy consumed is for air conditioning, lighting, lifts and domestic hot water with little process energy being used except for office equipment, computers and some food preparation.
- In factories and industrial buildings most energy is used in the process work being carried out whilst the provision of comfort conditions in the administration section

requires considerably less.

- Institutional buildings use considerably more for lighting and air conditioning with smaller process loads such as hospital sterilisation, medical equipment, laundries and food preparation.
- In commercial buildings most of the energy consumed is for air conditioning, lighting, lifts and domestic hot water with little process energy being used except for office equipment, computers and some food preparation.
- Premises with multiple sub-tenancies have two areas of usage:
 - (a) Central Services: This area includes all air conditioning (chilling, heating and air movement), domestic hot water, core lighting and lifts.
 - (b) Tenancies: This load includes area lighting, power and special purpose ventilation or air conditioning, all of which is metered and switched separately.

Catering Service Related Considerations

- The catering services in a hospital use 5-10% of the total energy consumption.
- The energy uses in a kitchen can be grouped into eight major consuming operations.
 - Food preparation
 - Cooking
 - Cooling
 - Serving and Storing
 - Heating
 - Ventilation and air conditioning
 - Sanitation
 - Lighting

Building Services Related Considerations

- Letting the air conditioning system operate on public holidays can increase your yearly energy costs by up to 4.5%.
- Hot water - The energy consumption for domestic hot water in an office building is close to 5% for a boiler system and 1% for local hot water units. many buildings have much higher consumption levels for this service due to inappropriate design.
- Lifts - Energy use by lift systems can be reduce by the use of stairs for travel between adjacent floors.
- In most plants, lighting accounts for about 25 percent of the total demand for electrical energy. If electrical consumption can be reduced, energy can also be saved through a lighting heat load reduction in air conditioned plants.

- Lighting constitutes 50% of energy consumption in typical office buildings.
- Lighting accounts for approximately 75% of the total electrical energy consumed by a school. The usage and cost for this energy may be reduced by as much as 30%.
- Dirty lamps reduce light output by 20%. Dirty interior room surfaces further reduce illumination by 15%. The additive effect of lamp life depreciation, lamp dirt depreciation and room surface dirt depreciation can reduce light output of the entire lighting system by as much as 50%.
- The wattage of a bulb does not measure the amount of light it gives, but rather the energy it needs. For example, a 100 watt bulb gives 50% more light than four 25 watt bulbs for the same amount of energy.
- Fluorescent lamps give 5 times the light and last up to 8 times longer than ordinary bulbs for the same energy input.

Energy Conservation Related Considerations

- Turning off unneeded equipment is perhaps the simplest and most obvious way to eliminate unnecessary energy use, but nevertheless, it is often overlooked.
- By reducing the energy consumption by 19 kWh/m²/annum will reduce your yearly energy costs by around \$25,000 for a 10,000 m² gross floor area building.

Health and Safety

- Do not compromise safety.
- Do not reduce standards of comfort/services below acceptable levels. Refer Appendix I.
- Overzealous attempts to save energy costs by reducing standards of comfort and services below accepted levels can be counter-productive.
- Solicit co-operation of staff.
- People are likely to regard with suspicion any changes in their workplace which they feel are being imposed upon them without their knowledge.

HIDDEN TRAPS

Inter Relationships

- Study the system carefully before making changes - some changes may increase energy usage.
- Consider the impact that changes in one aspect may have on another ie. lighting changes may result in additional mechanical ventilation. etc.
- The various energy consumers within a plant must not be considered piecemeal - a total approach must be taken.
- Many energy-consuming units are interrelated. For instance, inefficiencies in electric motors and lighting systems convert electricity to heat. If this heat is used within the building for space heating, such inefficiencies do not necessarily constitute energy losses. This approach is real *energy management*.

New Building Developments

- Initially energy saving should begin with the building design.
- Once a building has been constructed, it is generally much more difficult to incorporate energy-efficient features.

Conserve Water

- Too often, water is taken for granted, and overlooked in energy conservation.

HOUSE KEEPING

- Continuously operating ventilation fans, and heating or cooling huge quantities of outdoor air are wasteful.
- Use the most appropriate form of energy.
 - In some applications, a variety of energy sources can be used.
 - Each energy source has particular advantages and limitations.
- Ensure that levels of services do not exceed that required.
 - Don't request the provision of services, plant, equipment etc over the minimum required to perform the task efficiently.

TERMINOLOGY DEFINITIONS

- Active Energy Conservation - this means incorporating mechanical devices such as solar hot water units, solar operated curtain and blinds, solar fans etc into a building.
- Data logging - this means collecting and displaying information such as energy usage, demand level, system status, system failures and program parameters.
- Duty cycling - this means turning loads off for selected periods of time regardless of demand level.
- Energy audit - this is an investigation of energy use in an organisation to identify major areas of energy use and opportunities for achieving energy savings.
- Energy Conservation - this is the employment of energy saving measures which involve reducing waste and improving the efficiency of energy use.
- Passive Energy Conservation - this refers to the materials, colours, orientation, eaves overhang, and insulation incorporated into the building ie. non mechanical inclusions.
- Peak demand - this is the highest kilowatt load obtained during any demand interval of 30 minutes within the billing period of one month.
- Time of day programming - this means turning loads on and off, based on a real time schedule.
- Demand limit control - the turning of selected loads off, at least for a short time, when total building demand approaches a target limit.

WORKPLACE HEALTH & SAFETY REGULATIONS (APPENDIX I)

Space Ventilation

- For workplaces comply with AS 1668 Part II re ventilation rates;
- For space generated impurities:
 - use mechanical exhaust ventilation;
 - threshold limit values: to National Health & Medical Research Council data;
- For processes emitting impurities, steam, hot air, humid air:
 - provide capture hood/enclosure;
 - provide flue or exhaust ventilation;
 - discharge to be 600mm above roof ventilation openings;
 - discharge to outside to be 2.4m above source;
- Natural ventilation (called variable ventilation):

- required for non mechanically ventilated/air conditioned buildings;
- minimum unobstructed area: 5% floor area;
- half of ventilation area to be below a height of 2.25m above floor level;
- for mechanically ventilated/air conditioned facilities:
 - . provision for natural ventilation required;
 - . minimum unobstructed area: 2½% floor area;
 - . manually operated in emergent situations;
- o Mechanical ventilation:
 - provide for workrooms > 9m depth/width;
 - provide for workrooms > 18.3m wide and with < 3.6 floor to ceiling/roof cladding heights;
 - provide 4 air changes per hour (minimum);
- o Internal Combustion engines located internally:
 - to be partitioned off from workrooms;
 - exhaust to be piped to outside;
- o Fresh air supply:
 - provide 0.3m³ per minute per person (minimum);
 - increase fresh air quantity for CO₂ generating plant so that CO₂ concentration < 5000PPm;
- o Air recirculation prohibited from:
 - kitchens;
 - sanitary compartments;
 - garage;
 - workrooms which generate impurities;

Space Temperature

- o Minimum workplace temperature: 18°C
(unless process requires a lesser temperature);
- o For air conditioned premises:
 - inside temperature not to exceed: 24°C
(for outdoor shade temps up to 32°C);
 - inside temperature not to be > 8°K difference from shade temperature (when out door shade temps > 32°C);

- For non air conditioned premises:
 - inside temperature not to exceed: 25°C at 1.2m above floor (when outdoor temp < 22°C);
 - inside temperature not to exceed outdoor temp plus 3°K (when outdoor temp 22°C or greater);
 - processes emitting heat energy to have:
 - . water curtains or
 - . capture hood or
 - . low conductivity screens

Air Movement

- For air conditioned premises:
 - minimum air movement: 0.1m/s at body level;
 - maximum air movement: 0.2m/s at body level;
- For non air conditioned premises:
 - in accordance with the following table:

Inside Temperature		Minimum air movement required in metres per minute
Dry Bulb Temperature in Degrees Celsius	Wet Bulb Temperature in Degrees Celsius	
Under 24	any wet bulb temperature	9
24 and under 27	Under 21	9
	21 and over	30
27 and under 30	Under 18	9
	18 and under 21	30
	21 and over	60
30 and under 32	Under 18	30
	18 and over	60
32 and over	Any wet bulb temperature	60

- maintain at minimum practicable level for spaces 10°C or less (other than refrigerated spaces)
- for spaces 10°C or less air movement not to exceed 0.5m/s

Humidity

- For space humidification/air conditioning systems:

- occupied zone maximum RH limit: 60%
- occupied zone minimum RH limit: 25%

SECTION III

OPERATIONAL MANAGEMENT STRATEGIES

SECTION III : OPERATIONAL MANAGEMENT STRATEGIES

ACCOUNTABILITY

- Assign responsibility eg. to Heads of Departments/Regional Areas/Sections.
- "Charge" units, sections etc for their energy.

EMPLOYEE INVOLVEMENT

- Encourage employees to:
 - turn off lights when leaving work areas;
 - report leaking faucets, lavatory fixtures, piping,etc;
 - keep windows and outside doors closed;
 - leave thermostats at a constant setting to avoid forcing the system to cycle off and on;
 - turn off all tools and portable appliances when not in use.
- Assign the responsibility for tuning off designated items to specific employees.
- Instruct occupants and cleaners to close blinds at evening departure.

HOT LINE

- Establish a telephone number to report energy waste.

MONITORING

Historical Records

- Keep daily records that plot degree days against steam or chiller capacity used. These records will pinpoint unnecessary heating or cooling.
- Develop a heating schedule to satisfy building requirements. Record the operation for each building or control zone to arrive at a suitable schedule for actual heating required. Outside temperatures must be taken into consideration with the actual requirements to determine what hour the heating equipment can be turned off, when it must be turned on, or when it should be left on continuously.

Building Security

- Ensure that windows are locked and sealed to reduce infiltration.

New Construction Projects

- Monitor project construction activities for compliance with energy conservation requirements.

NEW FACILITIES

Project Energy Brief

- Develop an energy brief for new buildings which consists of the technical guidelines and basic requirements sought by the building owner in achieving an efficient and cost-effective development.
- Projects associated with existing installations should, as far as is practical, address that portion of the existing system directly affected by the extensions, to include cost effective energy conservation measures.
- Passive means to accomplish energy conservation should be employed where practical, and provided it does not result in any exorbitant initial investment cost premium, or lesser functional performance.
- The adoption of any conservation technique must not be detrimental in the sense that an over complex system evolves.
- The selected systems shall not only be economical to purchase and install but also demonstrate long-term benefit in efficiency, operating costs, reliability, maintainability and flexibility.
- Targets to be provided for energy utilisation in the operating and maintenance manuals for major systems and for the total building. The targets should be seasonally adjusted.

Technical Guidelines

- Develop technical guidelines which cover the areas of building planning; building features; energy purchasing and control; lighting and electrical systems; power systems; heating ventilation and air conditioning; equipment selection; domestic hot water; and lifts and hoists.
- Develop landscaping guidelines.

PROJECT DESIGN STAGE

- Establish at the building design stages the most suitable tariffs and fuel types to suit the building operation and usages pattern.
- Through effective building planning reduce energy consumption by ensuring that energy systems are not used unnecessarily and that appropriately sized systems operate under

variable building operation.

- Design decisions which impact on long-range operating costs must consider initial as well as life cycle costs and energy availability.
- Sun diagram reports not shadow diagrams should be compiled for all new applications to help determine the shape of new buildings.
- Use life cycle costing or investment costing methods for the selection of equipment.

DESIGN REVIEWS

- Reschedule operations whenever possible to second and third shift to get them off of the 10:00 am to 2:00 pm peak electric demand period.
- Plan work so that the whole plant can be shut down on given weekends.
- Reduce operating hours.

PROGRAMS

- Implement an energy conservation training program.
- Establish an obsolete equipment replacement program.
- Establish an on-going monitoring program.
- Establish what is the energy weekly and annual cycle. What is the energy use per unit product/m² of rentable area.
- Instigate a planned maintenance program.

SUPPORT MECHANISMS

- Equip Building Managers with means to evaluate the operating efficiency of the building and major components.

STAFFING

- Appoint an individual as the energy officer responsible for the implementation of the energy conservation program.
- Ascertain who can be appointed to assume "KW_{energy} Responsibility"?
- Use Security Patrol Officers to advise on worst offenders (lights/doors etc left on).
- Use Energy Wardens on a Departmental or building basis.

SYSTEMS

- Establish an energy accounting system based on energy-use metering (steam, power, gas, etc) by the various departments or production units.

SECTION IV

PROVISION OF ACCOMMODATION

SECTION IV : PROVISION OF ACCOMMODATION (Accommodation Changes/Refurbishment)

AFTER HOURS OPERATION

- Staff associated with frequent after hours operation should be located adjacent to the building perimeter to reduce the need for artificial lighting.
- Provide local switching of lighting for sections associated with frequent after hours operation.
- Use packaged air conditioning system concepts or dedicated air handling systems to serve areas required to be operational after hours on a frequent basis.

AIR CONDITIONING

- Use spot air conditioning of people when they are located far apart. (Each should have control over the air direction and velocity over them.)
- Eliminate or reduce the use of systems which require simultaneous heating and cooling. Systems that use energy to cool a specific volume of delivered air, and then reheat it for purposes of sophisticated control are wasteful.
- Do not heat or cool halls, passageways, lobbies, and storage rooms to the same degree as work areas.
- If there is round-the-clock operation in a small portion of a large building, such as computer rooms, security offices, or communications centres, use of packaged units or auxiliary service to that area permits major systems to be shutdown.
- Elimination of excessive fresh air when cooling or heating.

AIR HANDLING SYSTEMS

- Install heat recovery device to reclaim heat from building, kitchen, and process exhaust.
- Insulate duct work used for space heating/air conditioning and which is located in untreated spaces.
- Use low leakage dampers ie. 1% or less. (Standard dampers allow from 5% to 20% leakage when closed.)
- Use thermostatically controlled exhaust fans where employed to control excess heat build up. (eg. store rooms, warehouses).
- Use a carbon monoxide gas monitoring system to control car park exhaust system.

ALTERNATIVE ENERGY SOURCES

- Collect solar and wind energy for electrical power generation.

BUILDING STRUCTURE

Building Fabric

- Be aware of the building features which affect energy use efficiency are:
 - cross section and orientation
 - specific thermal resistance values for the building envelope
 - specific values for windows and other openings to minimise air infiltration.
 - specific values for glass
 - external building element finish and colours
 - materials used in the construction of building joints
 - quantity of glazing
 - light-coloured walls and ceilings reflect and diffuse light.
- Place windows and doors to allow breeze paths through the house in summer and yet zone the building to close down for winter warming.
- Ventilate attic spaces by natural ventilation.

Outside Air Infiltration

- Eliminate excessive crackage between double entry doors.
- Install weather stripping around windows and doors.
- Install automatically closing doors.
- Use an air lock, careful sealing of doors and windows to prevent any unnecessary heat loss from the building.

Public Access Areas

- Areas which require public access (keep access routes short and visible).
- Position public access areas on the ground and first floors (with well marked stair access).
- Put solar film on windows to cut cooling loads.
- Install solar screens on windows to reduce cooling loads.
- Increase building shading with double glazing, shade structures, solar treatment of clear

glass.

- Tinting of window glass, substitution of double-glazed insulating glass, and use of draperies and shades.
- Use reflective paint for hot metal window frames.
- Equip offices with blinds.
- Provide solar glazing.
- Use pergola's not only for shade but also wind breaks, and to assist with the cooling mode.
- For east and west windows cover with adjustable shutters linked to solar sensors which automatically close when the sun rises in summer and opens when the sun moves off that face of the building.
- Use a light coloured brick for the external faces.
- Use structural shades for external glazing.

Thermal Insulation

- Add additional insulation to roofs, ceilings, or walls where practical.
- Use the correct level and type of insulation.

CHILLED WATER INSTALLATIONS

- Insulate piping work located in unconditioned spaces.
- Reduce chilled water design flow quantities.
- Replace three way valves with two way valves and install variable speed pumping
- Insulate chilled water valves, piping etc to reduce heat gain.
- Use chilled water storage systems to flatten maximum electrical demand by shifting chiller operation to off-peak times.

COLDROOMS

- Refrigeration appliances operate at peak efficiency when filled, so choose a size based on the organisations needs.

COLD WATER SUPPLY

- Recycle water whenever possible. Water from flushing operations might be used for other purposes, and compressor cooling water might be used as boiler make up water.
- Toilet cisterns should be dual flush or, in the case of high rise buildings, very low flush.
- Urinal cisterns should incorporate an automatic dual flush cycle of 6 minutes when occupied and 6 hours when unoccupied.
- Cold water fountains should be switched by the energy management system so as to be off with the base lighting in the corridors.

COMBUSTION EQUIPMENT, BOILERS, INCINERATORS

- Replace atmospheric burners with powerburners.
- Install pressure controls on furnaces (industrial).
- Install automatic air-gas combustion controls.
- Preheat combustion air with waste heat.
- Boilers used for heating domestic hot water should not be used for space heating. Inefficient operation will result, in summer months, if combined boilers are used.
- High grade waste heat can be recovered from incineration of rubbish, although a high quality incinerator is necessary to avoid fouling the heat exchanger and the environment.

COMPRESSED AIR

- Substitute vacuum cleaners and low-pressure blowers for cleaning operations.

CONTROL CONCEPTS

- Install individual room control whenever possible.
- Install temperature control valves (self-contained) in radiators controlled by hand valves.
- Install building automation system if feasible.
- Use master switches for functional areas.
- Use time clocks, photo-electric cells, time delay switches, movement detectors, etc. to ensure that operating hours of the energy consuming plant are reduced to the minimum necessary.

- All major equipment should be metered.
- Provide centralised automated control system.
- Where space humidity level not critical use return chilled water sensors for chiller set capacity control. (Must carefully evaluate space dehumidification requirements prior to implementation of this measure.)
- Cold water fountains should be switched by the energy management system so as to be off with the base lighting in the corridors.
- Incorporate a holiday schedule program to switch plant off on public holidays.

CONTROL EQUIPMENT

- Use lock thermostats to prevent resetting by unauthorised personnel.
- Position room temperature sensors to sense return air stream and not supply air stream temperature.

COOLING WATER INSTALLATIONS

- Use condenser water to preheat domestic hot water.
- Lower condenser water temperature by increasing the air quantity in the cooling towers, improve condition of fill, pump quantities.
- Limit water circulation flow rate to satisfy minimum heat rejection load requirements.

EVAPORATIVE COOLING

- Use spot cooling of people when they are located far apart. (Each should have control over air direction and velocity over them.)
- Use evaporative cooling for human cooling when ever practical.
- Consider using waste water for roof sprays during the summer to reduce heat load on the plant.
- Do not cool halls, passageways, lobbies and storage areas to the same degree as work areas.

FURNISHINGS

- Interior colour and finishes preferences should take into consideration their impact on artificial lighting needs, especially for spaces where illumination must be provided on a

continuous basis.

- When redecorating, use light colours on ceilings and walls to achieve good illumination levels with less lighting.
- Use blinds, shades, and draperies on the sunny sides of buildings to reduce air conditioning loads.
- Use fully boxed curtain pelmets for curtains to provide a double air gap to the external windows.

GENERAL CONSIDERATIONS

- Has energy consuming equipment been selected to operate at peak efficiency in the predominant part of the load range.
- Simplify over complex system concepts.

GENERAL POWER (ELECTRICAL)

Electric Motor Drives

- Use proper sized motors. Grossly oversized motors operate at a low power factor.
- Consider the use of variable speed drives.
- Select high efficiency electric motors correctly sized for the required duty.
- Implement "switching off" capability of the different load classifications either manually or automatically when that peak demand limit is approached.

Metering

- Metering should be installed to permit monitoring energy use of lighting, HVAC, general power, lifts and fire services.
- The main switchboard should be divided into sections, to provide separate bulk metering of lighting, general power, HVAC and lift and fire services. Where this is not practicable, floor distribution boards shall have dual supplies for light and power respectively. However, if this is not economically sensible, then a single pulse metering of bulk power shall be provided at the main distribution board.

Power Supplies

- Where investigations indicate that a demand tariff (tariff 41) would be economical provision shall be made for same but the building should be initially placed under a general usage tariff.

- Provision should be made for summated metering for any site which will have multiple buildings.
- Consider battery back up power supplies as an alternative to standby generator sets.

HOT WATER (DOMESTIC)

Hot Water Generation

- Solar hot water systems are cost effective in new homes and save about 80% of the energy used for water heating. This saves about 2.4 Tonnes of CO₂ each year from going into the atmosphere.
- Consider alternative energy sources for hot water generation.
- Install local or separate domestic hot water systems separate to heating boiler system.
- Consider installation of solar heated hot water equipment.
- Use small domestic hot water boilers in summer to avoid a main boiler being used uneconomically at low load.
- Water heating times should wherever possible, take advantage of off-peak or night tariffs. If a demand limit controller is installed, it must control the heating of water, otherwise water heating should be heated on night rate tariff or failing that, be controlled by the time switch or the EMS.
- Hot water should wherever possible, be generated at the point of use rather than centrally generated and reticulated.
- The hot water system should be located as close as possible to the kitchen, where small amounts of hot water are used frequently. This reduces the heat losses from the pipe.

Hot Water Supply

- Insulate the first 2 metres of hot water pipe from the hot water system.
- Reduce water temperature to 55°C particularly for reticulated systems. Local boosting to a higher temperature should only be provided where necessary.
- Use low volume, high efficiency outlets for both hot and cold water. Flow limiters may be used where necessary.

HOT WATER (PROCESS)

Hot Water Distribution

- Reduce hot water flows.
- Use of hot water storage to reduce peak.
- Insulate all hot water lines, that pass through air conditioned areas.
- Use high temperature differentials between supply and return water.
- Maintain low velocities, hence low friction losses in pipes.
- Select pumps so that the operational point is on an efficient part of the pump characteristic curve.
- Use variable speed or two speed recirculation pumps.
- Use primary, secondary and even booster pumps on large systems.
- Use two-way control valves on heat exchange equipment.
- Hot water reticulation piping should be thermally insulated.

Hot Water Generation

- Hot water should wherever possible, be generated at the point of use rather than centrally generated and reticulated.
- Hot water storage heaters, especially those provided for high usage areas, should be located in an enclosed, non-ventilated and insulated enclosure.
- Hydrotherms should be time controlled by and EMS, ie. be automatically switched on prior to occupation and automatically switched off at the end of the day, or controlled by a RESET switch (manual ON automatic OFF).

LIFT INSTALLATIONS

- Where building occupants are engaged under flexible working hours or have different starting and finishing times the reduced peak demand levels should be allowed for in the selection of the lift system characteristics.
- Call buttons and switches in lifts and foyers should not be of the type likely to self-activate under unfavourable temperature and humidity conditions.
- High efficiency motors and equipment should be selected where possible.
- Where the lift system is likely to be used for extensive document transfer between floors, hoists or other document transfer systems should be evaluated as possible

alternatives.

- The lift control system should ensure that compulsory stops at certain floors and unsolicited empty trips are avoided.
- Use microprocessor control systems to reduce waiting intervals.

LIGHTING

Light Fittings

- Use fluorescent tubes, they use about a quarter of the electricity used by ordinary globes for the same output and they last about eight times as long. They can be switched on and off as often as you need without affecting operating cost.
- Install higher efficiency lighting systems where possible.
- Substitute light bulbs, fittings for long life, low watts, bright and light coloured, complying with recommended standards.
- Install efficient High Pressure Sodium (HPS) fittings in lieu of incandescent.
- Use high intensity discharge lamps for large indoor areas with high ceilings. (Augment with a few fluorescent lamps for safety reasons.)

Lighting Levels

- Reduce overall illumination levels.
- Use supplemental lighting for specific tasks instead of increasing the overall illumination for a given area.
- Utilise natural lighting in perimeter office spaces.
- Reduce lighting in areas not requiring higher levels: stock rooms, corridors, etc.
- Reduce parking lot lighting to minimum levels required for safety.
- Zone lights should reflect occupancy and functions at floor areas.
- Do not light non-task areas to the level of task areas. Uniform lighting often represents wasted energy. In work zones, bench, machine, or desk lamps can supplement a lower total area level. The nature of the work should dictate the illumination level. Simply remove bulbs if an area switch turns on more light than is needed.
- Take advantage of outside light from windows or skylights. This light should be supplemented by building lighting, possibly activated by light-sensitive switches.

Outside brightness or glare can be minimised by sun screens, shades, blinds, window coatings, and low transmission glass.

- Consider re-distribution of lights.
- Provide only necessary light levels to Australian standards.
- Arrange lighting circuits to correspond to areas uniformly illuminated by daylight, of differing task illumination requirements, or related to consistent occupation, as is most appropriate to economies of energy cost.
- Apply explicit daylight linking to areas where daylight levels are sufficient for some portion of the working day.
- Where mood lighting is required use compact fluorescent lamps wherever possible in preference to incandescent lighting.

Light Switching

- Install movement detectors in areas of very low and infrequent occupancy.
- Utilise multiple switching for selective lighting levels in offices, conference rooms, etc.
- Use timers or photocells to control outdoor lighting.
- Install time switches on light circuits to avoid lights being left on after hours.
- Investigate whether small-zone switching of general lighting and local switching of individual offices or areas can be installed?
- Install pneumatic delay light switches in low use areas.
- Co-ordinate the lighting layout with partitions and desk layouts and installing a system able to easily accommodate changes in floor layouts.

- Install switches and controls to reduce the number of lamps activated. The wiring should allow for easy relocation and addition of switching. Lighting should be automatically switched off at the end of occupation in each area and manually brought back into operation. Override switches should be timer controlled.
- Ensuring that switching in open office space is localised and that external and internal zones are controlled separately.
- Consider the use of movement detectors to switch and control external security lighting systems.
- Use automatic switching of lights by the buildings management system.
- Increase electrical circuits to give "switch off" flexibility.
- Use individual controls for selected fittings.
- Use automatic time switches for storage areas and in equipment rooms.
- Use low voltage control for remotely located fittings.
- Lighting circuits should be programmed for automatic disconnection at selected times, while permitting users to energise luminaries according to their needs.
- Lighting should be controlled by the EMS, and should be capable of automatic OFF and manual ON or OFF by use of 'RESET' switches at the user's location.
- If reset switching of lighting is inappropriate, consider the use of:
 - power-line carrier signalling, provided that signalling is not active-neutral or active earth;
 - timers;
 - ultrasonic or microwave movement detectors;
 - photo-electric sensors;
 - key-lock, magnetised card or similar.
- Use two way switching for corridors and large areas with two or more doors.
- Access lighting to theatrettes should be under microwave movement detector control, being energised when entry is detected, and de-energised when no movement is detected in the theatre for a period not less than eight minutes.
- External lighting, including that for access, security, landscape and car park, but not timed tennis courts, etc, should be controlled in conjunction with time and photo-electric control, by the EMS. Local ON/OFF control should not be provided.
- Install dedicated light switches for meeting/conference rooms.

- Install photo-electric cells to operate vehicle loading dock lighting.

POTABLE WATER SUPPLY

- Recycle water whenever possible. Water from flushing operations might be used for other purposes, and compressor cooling water might be used as boiler make up water.
- Toilet cisterns should be dual flush or, in the case of high rise buildings, very low flush.
- Urinal cisterns should incorporate an automatic dual flush cycle of 6 minutes when occupied and 6 hours when unoccupied.
- Cold water fountains should be switched by the energy management system so as to be off with the base lighting in the corridors.

PROCESS PLANT

- Recycling waste heat by equipment modification.
- Size hoods to ensure that only air adequate to satisfy requirements is discharged.
- Use automatic regulators on heat exchangers to control the volume of water used.
- Use push-pull ventilation on open surface tanks, 50 percent or more of the air can be saved.
- Study plant heating systems to determine if they are of correct design. (Many are not.)

PUMPING INSTALLATIONS

- Avoid high pressure pumping systems.
- Use primary, secondary and even tertiary pumps on large systems.
- Select pumps so that the operational point is on an efficient part of the pump characteristic curve.
- Use variable speed or two speed pump arrangements.
- Use two-way control valves on heat exchange equipment viz convert constant flow systems to variable flow systems where practical.

SPACE HEATING

- Replace worn pipe work/duct work insulation.

- Insulate the ceiling to reduce heat loss.
- Fill holes and seal gaps around openings that allow warm air to escape from the room.

SPACE HUMIDIFICATION

- Provide humidity control only to the extent required for local conditions, and specifically for the support of equipment.

SPACE VENTILATION

- Reduce exhaust air quantities from toilet rooms, laboratories, etc when feasible.
- Convert toilet room exhaust fans to operate only when room is occupied.
- Control the carpark exhaust fans by time clock and gas monitoring/detection equipment.
- Eliminate all unnecessary exhaust hoods and roof ventilators.
- Replace hoods that are too large and move quantities of air in excess of environmental or safety requirements.
- Use a direct air supply on exhaust hoods whenever possible to eliminate heating or cooling of large quantities of fresh make up air, then exhausting if outdoors.
- Install automatic ventilation controls, such as timeclocks tied in with equipment controls, to ensure operation only when needed.
- Connect ventilation fans in restrooms, kitchens, etc, so they operate in unison with light circuits.
- Avoid high pressure ventilation systems.
- Consider modular ventilation systems where significant differences in building operations or heating/cooling loads exist in different zones of the building.
- Provide outdoor ventilation to air conditioned spaces only when occupied.
- In rooms with limited natural ventilation use ceiling fans to improve the comfort of occupants.

STANDBY POWER

- Consider battery back up power supplies as an alternative to standby generator sets.

STEAM INSTALLATIONS

- Replace obsolete boiler plant.
- Increase of fuel storage capacity to provide larger reserves.
- Insulate steam heated dryers.
- Insulate all steam lines that pass through air conditioned areas.
- Use steam generators at point of requirement in lieu of a central steam boiler installation for steady state load situations.
- Generate steam at the point of use, rather than centrally generate and reticulate.

SECTION V

OPERATIONAL ACTIVITIES

SECTION V : OPERATIONAL ACTIVITIES

AFTER HOURS OPERATION

House Keeping Measures

- Provide advance notice to the Building Services Co-ordinator to permit building management systems to be re-programmed.
- Where feasible open building windows to provide ventilation instead of operating mechanical ventilation or air conditioning systems.
- Where practical switch air conditioning system to ventilation operation.
- Report observances of lighting, equipment etc left on in adjacent un-occupied areas.
- Use stairs for inter-floor travel.
- Use a jug to boil hot water instead of switching on the hot water boiling unit or urn.
- Where practical provide portable infra-red heaters for space heating of private offices for after hours occupation instead of operating the air conditioning system.
- Where practical, use a stand alone personal computer instead of the local area network.
- Where practical provide desk lamps for task as well as private office lighting.

Accommodation Refurbishments

- Staff associated with frequent after hours operation should be located adjacent to the building perimeter to reduce the need for artificial lighting.
- Provide local switching of lighting for sections associated with frequent after hours operation.
- Use packaged air conditioning system concepts or dedicated air handling systems to serve areas required to be operational after hours on a frequent basis.

CATERING/COOKING ACTIVITIES

House Keeping Measures

- For that small cooking job, use the correct small appliance instead of your range, such as frypan, deep fry cooker or a pressure cooker.
- For your toast, use your electric toaster instead of the griller on your range.

- Clean and maintain cooking equipment to maintain peak efficiency.
- Eliminate unnecessary hot plates, coffee pots, etc, and limit use of remaining ones.
- Use volume cooking to reduce equipment heat losses, it is much easier to control one big pot than several small ones.
- Provide ovens, fryers and cooking tables with adequate cooking loads all the time the heat is on.
- Heat only to the temperature required by the task.
- Do not turn thermostats too high in an attempt to heat up or cook faster.
- Cover pots with lids to retain heated air in the pot to decrease the cooking time and the heat losses.
- While baking or roasting limit the number of other items of cooking equipment being used.

Maintenance Measures

- Clean burners and coils of encrusted matter and check them periodically for correct functioning.
- Clean steam cooking equipment periodically to remove lime deposits, lime acts as an insulator and reduces the equipment's effectiveness.
- Clean air filters of grease and dust particles because dirty filters block air passages and can cause exhaust fans to use more energy. They can also be a fire hazard.
- Clean refrigeration coils of frost and dust, dirty coils reduce efficiency and cause the compressor to use more energy.
- If the pots and pans are bent or worn out replace them with good solid-based pots and pans to ensure good heat transfer.

CLEANING ACTIVITIES

House Keeping Measures

- Plan cleaning routines so that lighting is required to be on for the minimum period.
- Assign a person to be responsible for switching off lighting, air conditioning etc once the building or floor has been cleaned.

- Keep drapes/blinds drawn to minimise the impact of solar radiation.
- Keep windows and doors closed when the buildings air conditioning/space heating system is on.
- Ensure that cleaning activities do not disturb room thermostat settings.
- Use vacuum type collection equipment for external paved areas to remove leaf debris and not high pressure water cleaning equipment.

Maintenance Measures

- Report to maintenance staff/building services co-ordinator observances such as office equipment frequently left switched on, dripping taps, switches without labels, faulty door closures etc.

LAUNDRY ACTIVITIES

House Keeping Measures

- When the weather is suitable, use a clothes line instead of your clothes dryer.
- Use special features on your washing machine to save energy. Sud-savers allow you to reuse warm water several times. Soak cycles remove stubborn stains in one wash cycle.
- Use only the warm and cold water settings to save on energy required to heat water.
- Use the "solar" clothes dryer in your back yard as much as possible.
- Provide a clothes line under shelter, if possible, for times when it is raining.
- Only use your clothes dryer in emergencies.
- When using a clothes dryer -
 - Never overload your clothes dryer.
 - Never place clothes in dripping wet.
 - Never overdry the clothes. Experiment to find the right setting.
 - Always clean the lint filter after each operation.
 - Always use the correct temperature setting.
- When ironing, iron low temperature fabrics first to reduce warm up time.
- Iron large batches of clothing at one time to avoid wasting energy reheating the iron several times.
- Switch off the iron while ironing the last garment and finish ironing on the stored heat.

- Fold clothes carefully when taking them off the line to reduce the amount of ironing they require.
- Use cold water detergent in washers whenever possible.
- Combine operations where possible to reduce the number of washers.

OFFICE EQUIPMENT USAGE/PURCHASES

House Keeping Measures

- Switch office equipment off after hours such as computers, printers, photocopiers, shredders, displays.
- Replace worn out equipment with modern efficient equipment.
- Use a stand alone PC rather than a network system for after hours operation where practical.
- Do not locate heat producing equipment below or within one to two metres of the air conditioning systems room temperature sensor/thermostat.
- Operations requiring the use of high energy consuming equipment for prolonged periods should be re-scheduled where possible so that the operational activity does not occur around the period of "peak demand" for building electricity usage.
- Undertake a periodic audit of equipment usage/units processed to identify abnormal usage or wastage.
- Equipment with air filtering devices should have the filter element replaced/cleaned on a regular basis.
- Install a notice adjacent to equipment to remind staff to switch off the item after use or end of day as appropriate.

New Equipment Purchases

- Purchase reverse cycle air conditioner units for cooling and heating applications.
- Select units with the highest co-efficient of performance or energy star rating.
- Select equipment with variable processing capacity capability rather than a single capacity unit.
- Select equipment which has on/off switches mounted in a readily accessible/visible position.

- Select equipment with lockable on/off switches or integral metering devices.
- Select equipment with a ducted ventilation exhaust air feature over one which exhausts hot air directly into the office space.
- Select equipment on the basis of that with the highest capability to operate under non-air conditioned/mechanically ventilated conditions.

SECTION VI

BUILDING ELEMENTS & INFRA STRUCTURE

SECTION VI : BUILDING ELEMENTS & INFRA STRUCTURE

ALTERNATIVE ENERGY SOURCES

House Keeping Measures

- Salvage all oil used in the plant. It can either be reused by refining it or burned in the boilers.
- Analyse all solid waste to determine whether it can be recycled, burned, or composted.

Installation Refurbishments

- Collect solar and wind energy.

BUILDING STRUCTURE

Building Refurbishments

- Add additional insulation to roofs, ceilings, or walls where practical.
- Ventilate attic spaces.
- Put solar film on windows to cut cooling loads.
- Install solar screens on windows to reduce cooling loads.
- Eliminate excessive crackage between double entry doors.
- Install weather stripping around windows and doors.
- Increase building shading with double glazing, shade structures, solar treatment of clear glass.
- Tinting of window glass, substitution of double-glazed insulating glass, and use of draperies and shades.
- Use reflective paint for hot metal window frames.
- Equip offices with blinds.
- Areas which require public access (keep access routes short and visible).

- Be aware of the building features which affect energy use efficiency are:
 - cross section and orientation
 - specific thermal resistance values for the building envelope
 - specific values for windows and other openings to minimise air infiltration.
 - specific values for glass
 - external building element finish and colours
 - materials used in the construction of building joints, and
 - quantity of glazing.
- Install automatically closing doors.
- Position public access areas on the ground and first floors (with well marked stair access).
- Provide solar glazing.
- Use the correct level and type of insulation.
- Place windows and doors to allow breeze paths through the house in summer and yet zone the building to close down for winter warming.
- Use pergola's not only for shade but also wind breaks, and to assist with the cooling mode.
- Use an air lock, careful sealing of doors and windows to prevent any unnecessary heat loss from the building.
- For east and west windows cover with adjustable shutters linked to solar sensors which automatically close when the sun rises in summer and opens when the sun moves off that face of the building.
- Use a light coloured brick for the external faces.
- Use light-coloured walls and ceilings to reflect and diffuse light.
- Use structural shades for external glazing.

Housekeeping Measures

- Keep garage and warehouse doors closed as much as possible.
- Use fire stairs as a major method of interfloor movement.

Maintenance Measures

- When re-roofing, use light coloured material to reduce solar gain on air conditioned structures.
- Reseal curtain walls.
- Repair broken windows.
- Maintain caulking, weather stripping, door seals, etc to reduce infiltration.
- Insulate building fabric where accessible.
- Install window shades or blinds.
- Seal around doors and windows to reduce ingress of outside air.
- Install roof thermal insulation to achieve an effective thermal resistance of at least 2.5.

AIR CONDITIONERS (ROOM)

House Keeping Measures

- Don't leave cooling appliances on when rooms are unoccupied.

Maintenance Measures

- See that air conditioner filters and condenser coils are kept clean.
- Replace obsolete equipment.

New Equipment Purchases

- Use reverse cycle units for cooling and heating applications.
- Select units with the highest co-efficient of performance.

AIR CONDITIONING

Installation Refurbishments

- Use spot air conditioning of people when they are located far apart. (Each should have control over the air direction and velocity over them.)

- Eliminate or reduce the use of systems which require simultaneous heating and cooling. Systems that use energy to cool a specific volume of delivered air, and then reheat it for purposes of sophisticated control are wasteful.
- Do not heat or cool halls, passageways, lobbies, and storage rooms to the same degree as work areas.
- If there is round-the-clock operation in a small portion of a large building, such as computer rooms, security offices, or communications centres, use of packaged units or auxiliary service to that area permits major systems to be shutdown.
- Elimination of excessive fresh air when cooling or heating.

System Operation

- Turn off air conditioning machinery during unoccupied hours.
- Set air conditioning operating times to reflect occupancy times.
- Stagger starting times of air conditioning equipment.
- Delete/reduce air conditioning in store rooms that was previously office space.
- Do not air condition buildings when they are unoccupied.
- If air conditioning is required sporadically, and where practical, consider the provision of stand-alone plant subject to remote full or partial de-energization by the Energy Management System.

Maintenance Measures

- Re-adjust temperature set points; up for summer to 25°C - down for winter to 20°C.

AIR HANDLING SYSTEMS

Installation Refurbishments

- Install heat recovery device to reclaim heat from building, kitchen, and process exhaust.
- Insulate duct work used for space heating/air conditioning and which is located in untreated spaces.
- Use low leakage dampers ie. 1% or less. (Standard dampers allow from 5% to 20% leakage when closed.)
- Use thermostatically controlled exhaust fans where employed to control excess heat

build up. (eg. store rooms, warehouses).

- Use a carbon monoxide gas monitoring system to control car park exhaust system.

Maintenance Measures

- Retest, balance, and adjust systems.
- Reduce system air volume to design values.
- Reduce air duct leakage by caulking ductwork.
- Replace worn duct work insulation.
- Implement a filter maintenance program to ensure peak efficiency.
- Reduce the number of air changes from the traditional standard of six per hour, if this can be done safely.
- Clean air filters of grease and dust particles because dirty filters block air passages and can cause exhaust fans to use more energy. They can also be a fire hazard.
- Provide outdoor ventilation to air conditioned spaces only when occupied.

System Operation

- Whenever possible, only operate return air fans for heating during unoccupied hours.

CHILLED WATER INSTALLATIONS

House Keeping Measures

- Optimise multiple chiller operation.
- Use minimum number of chillers. (It is far better to operate one unit at 90 percent than two at 45 percent.)
- Operate smaller chillers at high load rather than larger chillers at low load.
- Attempt to operate at higher chilled water temperature and lower condensing water temperature.

Installation Refurbishments

- Insulate piping work located in unconditioned spaces.
- Reduce chilled water design flow quantities.
- Replace three way valves with two way valves and install variable speed pumping
- Insulate chilled water valves, piping etc to reduce heat gain.
- Use chilled water storage systems to flatten maximum electrical demand by shifting chiller operation to off-peak times.

Maintenance Measures

- Reset chilled water and heating water temperature in accordance with loads.
- Replace worn pipe work insulation.
- Repair all leaks.
- Use no more water treatment chemicals than necessary.
- Use correct water treatment chemicals to reduce fouling of transfer surfaces in heat exchangers.

COLD ROOMS

House Keeping Measures

- Don't open the coldroom door needlessly. Learn to remove and replace several articles at once, as this will reduce the loss of cold air.
- Allow hot foods to cool slightly before placing in the coldroom. (But to prevent bacterial growth no more than about 20 minutes standing time.)
- Check the door seal is still in good condition. (Close the door on a piece of paper, if the paper can be removed easily then the seal should be replaced.)
- Remove heavy wrapping and styrene packaging before storing food in the refrigerator or freezer.
- Thick frost reduces the cooling ability of refrigeration plant. Defrost on a regular basis.

Installation Refurbishment

- Refrigeration appliances operate at peak efficiency when filled, so choose a size based on the organisations needs.

Maintenance Measures

- Coldroom condensing equipment needs to be kept clean and well ventilated for efficient operation.

COMBUSTION EQUIPMENT (BOILERS, INCINERATORS)

Housekeeping Measures

- Shut off drying and curing ovens when not in use. Do not start too soon prior to the shift.

Installation Refurbishments

- Replace atmospheric burners with powerburners.
- Install pressure controls on furnaces (industrial).
- Install automatic air-gas combustion controls.
- Preheat combustion air with waste heat.
- Boilers used for heating domestic hot water should not be used for space heating. Inefficient operation will result, in summer months, if combined boilers are used.
- High grade waste heat can be recovered from incineration of rubbish, although a high quality incinerator is necessary to avoid fouling the heat exchanger and the environment.

Maintenance Measures

- Check flues and chimneys for blockages or improper draft conditions.
- Clean combustion surfaces.
- Repair furnace linings frequently.
- Seal all cracks in furnaces, ovens, etc.
- Replace worn insulation on boilers and furnaces.
- Use correct water treatment chemicals to reduce fouling of transfer surfaces.

System Operation

- Do not overfire equipment.
- Reduce production equipment preheat times to minimum required.
- Reduce production equipment (furnaces, ovens, etc) temperatures to holding temperatures when production stops for relatively long periods.
- Determine whether the boiler plant can be shut down for the summer and small boilers and water heaters used during this period.
- Ensure that burners (stokers) are adjusted to maintain minimum excess air requirements.
- Use the minimum number of boilers. It is far better to operate one unit at 90 percent capacity than two at 45 percent.

COMPRESSED AIR

Housekeeping Measures

- Do not use compressed air to cool people. Such cooling is both wasteful and dangerous.
- Use hot air from blowers for drying parts and not compressed air.
- Shut off compressed air on all equipment during non-operating hours.
- Establish a shutoff-valve inspection program to minimise leakage losses. It is interesting to note the costs of compressed air leaks.
- Do not use compressed air at higher pressures than required.
- Do not permit compressed air to be used for "people" cooling.

Installation Refurbishments

- Substitute vacuum cleaners and low-pressure blowers for cleaning operations.

Maintenance Measures

- Repair all leaks.

CONTROL SYSTEMS

Housekeeping Measures

- Don't fiddle with equipment controls/room temperature controller.

Installation Refurbishments

- Use lock thermostats to prevent resetting by unauthorised personnel.
- Install individual room control whenever possible.
- Install temperature control valves (self-contained) in radiators controlled by hand valves.
- Install building automation system if feasible.
- Use master switches for functional areas.
- Use time clocks, photo-electric cells, time delay switches, movement detectors, etc. to ensure that operating hours of the energy consuming plant are reduced to the minimum necessary.
- All major equipment should be metered.
- Provide centralised automated control system.
- Where space humidity level not critical use return chilled water sensors for chiller set capacity control. (Must carefully evaluate space dehumidification requirements prior to implementation of this measure.)
- Cold water fountains should be switched by the energy management system so as to be off with the base lighting in the corridors.
- Incorporate a holiday schedule program to switch plant off on public holidays.
- Position room temperature sensors to sense return air stream and not supply air stream temperature.

Maintenance Measures

- Check calibration of all controls on a regular basis.
- Check room thermostats for proper location (not on cold walls, in drafts or receiving direct solar radiation).
- Increase internal temperature thermostat set points in summer and decrease setpoints in

winter.

- Replace existing controls with ones of greater reliability.
- Label switches.
- Alter temperature controls for chilled and heating water, with respect to outside temperatures.
- Adjust warm-up and shut-down cycles.
- Monitor controls and fit kWh meters to main plant to facilitate monitoring.

COOLING WATER INSTALLATIONS

Installation Refurbishments

- Use condenser water to preheat domestic hot water.
- Lower condenser water temperature by increasing the air quantity in the cooling towers, improve condition of fill, pump quantities.
- Limit water circulation flow rate to satisfy minimum heat rejection load requirements.

Maintenance Measures

- Repair all leaks.
- Check cooling tower bleed-off periodically to ensure that water and chemicals are not wasted.
- Maintain cooling towers to maintain peak efficiency by cleaning regularly.
- Use no more water treatment chemicals than necessary.
- Use proper water treatment to reduce fouling of transfer surfaces, heat exchangers.

EVAPORATIVE COOLING

Installation Refurbishments

- Use spot cooling of people when they are located far apart. (Each should have control over air direction and velocity over them.)
- Use evaporative cooling for human cooling when ever practical.
- Consider using waste water for roof sprays during the summer to reduce heat load on the

plant.

- Do not cool halls, passageways, lobbies and storage areas to the same degree as work areas.

Maintenance Refurbishments

- Maintain evaporative coolers to maintain peak efficiency by cleaning regularly.

GENERAL CONSIDERATIONS

Installation Refurbishments

- Has energy consuming equipment been selected to operate at peak efficiency in the predominant part of the load range.
- Simplify over complex system concepts.

GENERAL POWER (ELECTRICAL)

Installation Refurbishments

- Use proper sized motors. Grossly oversized motors operate at a low power factor.
- Consider battery back up power supplies as an alternative to standby generator sets.
- Select high efficiency electric motors correctly sized for the required duty.
- Consider the use of variable speed drives.
- Implement "switching off" capability of the different load classifications either manually or automatically when that peak demand limit is approached.

Supply

- Where investigations indicate that a demand tariff (tariff 41) would be economical provision shall be made for same but the building should be initially placed under a general usage tariff.
- Provision should be made for summated metering for any site which will have multiple buildings.

Metering

- Metering should be installed to permit monitoring energy use of lighting, HVAC, general power, lifts and fire services.
- The main switchboard should be divided into sections, to provide separate bulk metering

of lighting, general power, HVAC and lift and fire services. Where this is not practicable, floor distribution boards shall have dual supplies for light and power respectively. However, if this is not economically sensible, then a single pulse metering of bulk power shall be provided at the main distribution board.

House Keeping Measures

- Identify peak load periods and reschedule equipment (especially large motors, ovens, furnaces, etc) for off peak periods.
- Update or replace inefficient equipment.
- Reduce duplicating costs, better planning. Departments copy documents sent to Heads of Departments only.
- Schedule building loads so that they do not appear on the system simultaneously.

Maintenance Measures

- Check snow and ice-melting equipment, and heating tapes, to make sure they are shut off when not in use.
- Replace oversized, inefficient motors.
- Make sure electrical power is not bleeding off to ground.
- Add time clock controls to equipment to turn it off when it is not needed.

HOT WATER (DOMESTIC)

Housekeeping Measures

- Don't boil water on a hotplate - use an electric kettle or jug and fill from the cold tap. Running off a lot of cold water from the hot pipes is expensive.
- Switch off your hot water system when on holiday.
- Reduce hot water supply temperature of domestic hot water systems when fitted with adjustable temperature control.
- Have short showers. Only half fill the kitchen sink when washing up.
- Don't rinse the dishes with running hot water. Only half fill the kitchen sink when washing up.
- Use warm water or better still cold water in your clothes washing machine.

- Turn off hot water system when going away on holidays for more than a few days.
- Explore whether temperature of domestic hot water can be reduced?

Installation Refurbishments

- Solar hot water systems are cost effective in new homes and save about 80% of the energy used for water heating. This saves about 2.4 Tonnes of CO₂ each year from going into the atmosphere.
- The hot water system should be located as close as possible to the kitchen, where small amounts of hot water are used frequently. This reduces the heat losses from the pipe.
- Insulate the first 2 metres of hot water pipe from the hot water system.
- Reduce water temperature to 55°C particularly for reticulated systems. Local boosting to a higher temperature should only be provided where necessary.
- Use low volume, high efficiency outlets for both hot and cold water. Flow limiters may be used where necessary.
- Consider alternative energy sources for hot water generation.
- Install local or separate domestic hot water systems separate to heating boiler system.
- Consider installation of solar heated hot water equipment.
- Use small domestic hot water boilers in summer to avoid a main boiler being used uneconomically at low load.
- Water heating times should wherever possible, take advantage of off-peak or night tariffs. If a demand limit controller is installed, it must control the heating of water, otherwise water heating should be heated on night rate tariff or failing that, be controlled by the time switch or the EMS.
- Hot water should wherever possible, be generated at the point of use rather than centrally generated and reticulated.

Maintenance Measures

- Hot water can account for up to 50% of your house's energy use. Fix dripping taps quickly. 60 drips per minute add up to 9000 litres of water per year wasted.
- Install a water-saving shower rose. This can save up 50% of the energy used for water heating.
- Install time clocks on kitchen hydroboil units.

- Install water saving devices on hot water taps.
- Check system vents in hot water systems for proper performance.
- Repair all leaks.
- Reduce domestic hot water flow by installing flow limiting devices.
- Maintain tap washers.
- Replace conventional shower heads with flow-reduced shower heads that limit flow to about 9 litres/minute.
- Install flow-limiting valves for washbasin services or flow-limited tap aerators which prevent flow exceeding 6 litres/minute. (Do not fit to kitchen service points.)

HOT WATER (PROCESS)

Installation Refurbishments

- Reduce hot water flows.
- Use of hot water storage to reduce peak.
- Insulate all hot water lines, that pass through air conditioned areas.
- Use high temperature differentials between supply and return water.
- Maintain low velocities, hence low friction losses in pipes.
- Select pumps so that the operational point is on an efficient part of the pump characteristic curve.
- Use variable speed or two speed recirculation pumps.
- Use two-way control valves on heat exchange equipment.
- Use primary, secondary and even booster pumps on large systems.
- Hot water should wherever possible, be generated at the point of use rather than centrally generated and reticulated.
- Hot water reticulation piping should be thermally insulated.
- Hot water storage heaters, especially those provided for high usage areas, should be

located in an enclosed, non-ventilated and insulated enclosure.

- Hydrotherms should be time controlled by and EMS, ie. be automatically switched on prior to occupation and automatically switched off at the end of the day, or controlled by a RESET switch (manual ON automatic OFF).

Maintenance Measures

- Repair all leaks.

LIFT INSTALLATIONS

House Keeping Measures

- Discourage use of lifts for travel to adjacent floors.

Installation Refurbishments

- Where building occupants are engaged under flexible working hours or have different starting and finishing times the reduced peak demand levels should be allowed for in the selection of the lift system characteristics.
- The lift control system should ensure that compulsory stops at certain floors and unsolicited empty trips are avoided.
- Call buttons and switches in lifts and foyers should not be of the type likely to self-activate under unfavourable temperature and humidity conditions.
- High efficiency motors and equipment should be selected where possible.
- Where the lift system is likely to be used for extensive document transfer between floors, hoists or other document transfer systems should be evaluated as possible alternatives.
- Use microprocessor control systems to reduce waiting intervals.

Maintenance Measures

- Reduce the number of after hours lifts usage, increase waiting times etc.
- The lift control system should be programmed to ensure operational efficiency under expected occupant movement patterns.

LIGHTING

House Keeping Measures

- Switch external building lighting off between the hours of midnight to dawn.
- Reduce decorative and advertising lighting.
- Encourage all staff to turn off lights when they are leaving a room for more than a few minutes.
- Restarting a lamp does not use any extra electricity, although turning a fluorescent lamp on-and-off does slightly reduce its lifetime. Therefore, it will still save money to turn off a fluorescent lamp if it will not be needed for more than 15 minutes.
- Remove light bulbs in areas of excessive lighting.
- Reduce lighting for cleaning crews.
- Encourage cleaners turn lights off after cleaning.
- Do not turn fluorescent lights on and off too often.
- Reduce often excessive lighting levels particularly in service areas such as lift lobbies and corridors.
- Minimise use of floor and display lighting.
- Avoid using multi-level lamps, eg. 100/150/200 watt.

Installation Refurbishments

- Install movement detectors in areas of very low and infrequent occupancy.
- Use fluorescent tubes, they use about a quarter of the electricity used by ordinary globes for the same output and they last about eight times as long. They can be switched on and off as often as you need without affecting operating cost.
- Install higher efficiency lighting systems where possible.
- Reduce overall illumination levels.
- Use supplemental lighting for specific tasks instead of increasing the overall illumination for a given area.
- Utilise natural lighting in perimeter office spaces.

- Utilise multiple switching for selective lighting levels in offices, conference rooms, etc.
- Reduce lighting in areas not requiring higher levels: stock rooms, corridors, etc.
- Use timers or photocells to control outdoor lighting.
- Reduce parking lot lighting to minimum levels required for safety.
- Zone lights to reflect occupancy and functions at floor areas.
- Substitute light bulbs, fittings for long life, low watts, bright and light coloured, complying with recommended standards.
- Install time switches on light circuits to avoid lights being left on after hours.
- Investigate whether small-zone switching of general lighting and local switching of individual offices or areas can be installed?
- Do not light non-task areas to the level of task areas. Uniform lighting often represents wasted energy. In work zones, bench, machine, or desk lamps can supplement a lower total area level. The nature of the work should dictate the illumination level. Simply remove bulbs if an area switch turns on more light than is needed.
- Take advantage of outside light from windows or skylights. This light should be supplemented by building lighting, possibly activated by light-sensitive switches. Outside brightness or glare can be minimised by sun screens, shades, blinds, window coatings, and low transmission glass.
- Install local switches which trip off when master switch goes off.
- Arrange centrally controlled lights so they are capable of local switching off.
- Install pneumatic delay light switches in low use areas.
- Co-ordinate the lighting layout with partitions and desk layouts and installing a system able to easily accommodate changes in floor layouts.
- Install switches and controls to reduce the number of lamps activated. The wiring should allow for easy relocation and addition of switching. Lighting should be automatically switched off at the end of occupation in each area and manually brought back into operation. Override switches should be timer controlled.
- Ensuring that switching in open office space is localised and that external and internal zones are controlled separately.
- Consider the use of movement detectors to switch and control external security lighting systems.

- Use automatic switching of lights by the buildings management system.
- Install efficient High Pressure Sodium (HPS) fittings in lieu of incandescent.
- Consider re-distribution of lights.
- Increase electrical circuits to give "switch off" flexibility.
- Provide only necessary light levels to Australian standards.
- Use individual controls for selected fittings.
- Use automatic time switches for storage areas and in equipment rooms.
- Use low voltage control for remotely located fittings.
- Use high intensity discharge lamps for large indoor areas with high ceilings. (Augment with a few fluorescent lamps for safety reasons.)
- Lighting circuits should be programmed for automatic disconnection at selected times, while permitting users to energise luminaries according to their needs.
- Lighting should be controlled by the EMS, and should be capable of automatic OFF and manual ON or OFF by use of 'RESET' switches at the user's location.
- If reset switching of lighting is inappropriate, consider the use of:
 - power-line carrier signalling, provided that signalling is not active-neutral or active earth;
 - timers;
 - ultrasonic or microwave movement detectors;
 - photo-electric sensors;
 - key-lock, magnetised card or similar.
- Arrange lighting circuits to correspond to areas uniformly illuminated by daylight, of differing task illumination requirements, or related to consistent occupation, as is most appropriate to economies of energy cost.
- Apply explicit daylight linking to areas where daylight levels are sufficient for some portion of the working day.
- Where mood lighting is required use compact fluorescent lamps wherever possible in preference to incandescent lighting.
- Use two way switching for corridors and large areas with two or more doors.

- Access lighting to theatrettes should be under microwave movement detector control, being energised when entry is detected, and de-energised when no movement is detected in the theatrette for a period not less than eight minutes.
- External lighting, including that for access, security, landscape and car park, but not timed tennis courts, etc, should be controlled in conjunction with time and photo-electric control, by the EMS. Local ON/OFF control should not be provided.
- Install dedicated light switches for meeting/conference rooms.
- Install photo-electric cells to operate vehicle loading dock lighting.

Maintenance Measures

- Implement a lighting maintenance program to obtain maximum efficiency from existing systems.
- Revise clean up schedule so lights and systems can be turned off earlier.
- Replace incandescent lamps with fluorescent whenever possible. Although incandescent lamps do not require replacement as often, they are less than 30 percent as efficient as fluorescent.
- Replace burned-out and darkened lamps.
- Label light switches to minimise inadvertent switching.
- Replace incandescent fittings with fluorescent or PL types.
- Replace with lower wattage lamps.
- Remove alternate fluorescent fixtures from continuous rows without reducing the lighting level recommended for its particular function.
- Reduce 4 lamp fluorescent fixtures to 2 lamps.
- Replace existing fittings with lower intensity fittings.
- Avoid using extended service lamps as they are notoriously inefficient.

MATERIALS HANDLING/TRANSPORT

House Keeping Measures

- Analyse interplant truck runs. Consolidate loads and eliminate trips.
- Shut off interplant truck engines when not in use.

- Shut off fork lift engines when not in use.

POTABLE WATER SUPPLY

House Keeping Measures

- Control the amount of lawn sprinkling.

Installation Refurbishments

- Recycle water whenever possible. Water from flushing operations might be used for other purposes, and compressor cooling water might be used as boiler make up water.
- Toilet cisterns should be dual flush or, in the case of high rise buildings, very low flush.
- Urinal cisterns should incorporate an automatic dual flush cycle of 6 minutes when occupied and 6 hours when unoccupied.
- Cold water fountains should be switched by the energy management system so as to be off with the base lighting in the corridors.

Maintenance Measures

- Adjust valves on toilets and urinals. A considerable amount of water is wasted in most toilet and urinal flushing. Savings may be gained by properly adjusting valves in water closets to the following acceptance levels:

Volume of discharge	3.8 gallons
Period of discharge	12.8 seconds
Average rate of flow	17.8 gpm

Water volume in urinals should be only sufficient to thoroughly flush the fixture and refill the fixture trap.

- Check underground domestic water and fire mains for leaks.
- Install and monitor pressure gauges on water services and mains.
- Repair leaky faucets immediately.

PROCESS PLANT

House Keeping Measures

- Ascertain how much heat is lost in plant effluents and whether it can be reclaimed.
- Ascertain if waste heat from dryers can be recycled?
- Reduce waste heat by improved operation, insulation, etc.
- Lower the level of energy use by reducing process temperatures where practical.
- Check combustion and temperature controls periodically to prevent overheating.
- Shut down furnaces and ovens when they will be idle for extended periods.
- Schedule charge loads to take maximum advantage of heating periods and avoid unnecessary peaking periods.
- Check water temperature, recovery capacity, and insulated pipes on water heaters to assure maximum water utilisation.
- Use immersion heaters whenever possible.
- Shut off machinery when not in use: lunch, etc.
- Keep covers on tanks and vats closed to reduce evaporation losses.

Installation Refurbishments

- Recycling waste heat by equipment modification.
- Size hoods to ensure that only air adequate to satisfy requirements is discharged.
- Use automatic regulators on heat exchangers to control the volume of water used.
- Use push-pull ventilation on open surface tanks, 50 percent or more of the air can be saved.
- Study plant heating systems to determine if they are of correct design. (Many are not.)

Maintenance Measures

- Maintain all insulated surfaces properly to prevent unnecessary heat losses.
- Maintain heat exchanger surfaces properly to prevent using excessive quantities of

water.

- Repair leaking process or boiler water lines. This problem amplifies the loss since water treatment is also wasted.

PUMPING INSTALLATIONS

- Investigate measures to reduce water consumption to be pumped by sump pumps and sewerage pumps.

Installation Refurbishments

- Avoid high pressure pumping systems.
- Select pumps so that the operational point is on an efficient part of the pump characteristic curve.
- Use variable speed or two speed pump arrangements.
- Use two-way control valves on heat exchange equipment viz convert constant flow systems to variable flow systems where practical.
- Use primary, secondary and even tertiary pumps on large systems.

Maintenance Measures

- Clean strainer screens in pumping systems.
- Repair all leaks.
- Repair or replace pump packing glands that drip excessively.

REFRIGERATION (PRODUCT)

House Keeping Measures

- Place refrigerators and deep freezers in a well ventilated position. It should not be built-in unless designed for that purpose and fitted with a fan-cooled condenser.
- Place refrigerators and deep freezers away from direct sunlight and any other surface of heat such as a range or a dishwasher.
- Refrigeration appliances operate at peak efficiency when filled, so when buying, choose a size based on your staffs needs.
- Allow adequate space all round the fridge or freezer for free circulation of air to remove heat.

- Don't open the refrigerator or freezer door needlessly. Learn to remove and replace several articles at once, as this will reduce the loss of cold air.
- Allow hot foods to cool slightly before placing in the refrigerator or freezer. (But to prevent bacterial growth no more than about 20 minutes standing time.)
- Remove heavy wrapping and styrene packaging before storing food in the refrigerator or freezer.
- Thick frost reduces the cooling ability of refrigeration. Defrost when the ice is between 6 to 13 mm thick ($\frac{1}{4}$ to $\frac{1}{2}$ inch).
- Turn off, empty, clean and leave door open when taking an extended holiday.

Maintenance Measures

- Condenser coils at the rear of the fridge need to be kept clean for efficient operation. Use the vacuum cleaner with a brush attachment to clean the coils.
- Check the door seal is still in good condition. (Close the door on a piece of paper, if the paper can be removed easily then the seal should be replaced.)

SPACE HEATING

House Keeping Measures

- Reduce heating in unoccupied areas.
- Reduce heating in overheated spaces. Do not open the window to cool these areas!
- Whenever possible, only operate return air fans for building pre-heating during unoccupied hours.
- Encourage staff to dress for the cold. It is far cheaper to put on warm clothes than to turn on a heater to keep warm.
- Close off the room you are heating. It is more energy-efficient to heat a small room than an large open-plan living area.
- Provide notices on space heating on/off switches.
- "No point in switching lights/equipment off in winter if heating load increases."
(Comment only valid for electrical heating).
- Keep heat and smoke relief vents closed during the winter.

- Maintain a lower temperature in winter. Most buildings are heated in excess of the National Comfort Index. "Thermal comfort conditions", as defined by the American Society of Heating, Refrigerating and Air Conditioning Engineers, generally exist when the air temperature is in the range of 22⁰ C to 25⁰ C. Maintain temperatures in the low end (22⁰ C) of the range in the winter vs the middle (24⁰ C) year-round. For heating, temperatures of less than 21⁰ C are generally acceptable in areas where the work performed involves some physical activity.

Installation Refurbishments

- Replace worn pipe work/duct work insulation.
- Insulate the ceiling to reduce heat loss.
- Fill holes and seal gaps around openings that allow warm air to escape from the room.

Maintenance Measures

- Replace forced air heaters with infrared heaters.
- Insulate piping and duct work located in non heated spaces.
- Reduce hot water design flow rates where practical to reduce pumping costs.
- Convert three-way valves to two-way operation and install variable speed pumping. (ie. Convert constant flow systems to variable flow systems).
- Provide close-fitting thick curtains, hanging from a box pelmet to the floor or a ledge, to reduce heat loss through windows.
- When selecting a heating system make sure it is appropriate for the size of room, activity carried out in the room and safety.
- Use radiant heaters for situations where people are congregated in one small area.
- Use oil-filled column and fan forced heaters for smaller rooms as they heat all the air in the room. The larger the area, the more energy will be required to heat the room.
- Use gas, wood-fired heating and reverse cycle air-conditioning (heat pump) forms of heating for large areas requiring heating for extended heating periods.
- Use reversible ceiling fans at low speed to circulate warm air from the ceiling around the room.
- Use spot heating of people when they are located far apart. Each should have control of the air direction and velocity over them.

- Do not heat halls, passageways, lobbies, and storage rooms to the same degree as work areas.
- Heat people, not vacant buildings. In unoccupied buildings with fire-protection systems (sprinklers), a dry type or antifreeze system can prevent damage from freezing. If this is not feasible, the building temperature should be maintained between 8⁰ C and 10⁰ C.
- Select heating equipment for efficient operation under net heating requirements for the building and installed such as to minimise thermal losses.
- Use natural gas fired plant rather than oil fired plant.
- Low grade heat may be able to be recovered for heating from exhaust air or refrigeration machines.

SPACE HUMIDIFICATION

Installation Refurbishments

- Provide humidity control only to the extent required for local conditions, and specifically for the support of equipment.

SPACE VENTILATION

House Keeping Measures

- Shut off exhaust fans during unoccupied cycles.
- Turn off exhaust hoods when not in use.

Installation Refurbishments

- Reduce exhaust air quantities from toilet rooms, laboratories, etc when feasible.
- Convert toilet room exhaust fans to operate only when room is occupied.
- Control the carpark exhaust fans by time clock and gas monitoring/detection equipment.
- Eliminate all unnecessary exhaust hoods and roof ventilators.
- Replace hoods that are too large and move quantities of air in excess of environmental or safety requirements.
- Use a direct air supply on exhaust hoods whenever possible to eliminate heating or cooling of large quantities of fresh make up air, then exhausting if outdoors.
- Install automatic ventilation controls, such as timeclocks tied in with equipment

controls, to ensure operation only when needed.

- Connect ventilation fans in restrooms, kitchens, etc, so they operate in unison with light circuits.
- Avoid high pressure ventilation systems.
- Consider modular ventilation systems where significant differences in building operations or heating/cooling loads exist in different zones of the building.
- Provide outdoor ventilation to air conditioned spaces only when occupied.
- In rooms with limited natural ventilation use ceiling fans to improve the comfort of occupants.

Maintenance Measures

- Check exhaust systems to ensure they are exhausting only the amount of air required.

STAND-BY POWER

Installation Refurbishments

- Consider battery back up power supplies as an alternative to standby generator sets.

Maintenance Measures

- Test standby diesel generator on building load to reduce electrical consumption.

STEAM INSTALLATIONS

Installation Refurbishments

- Replace obsolete boiler plant.
- Increase of fuel storage capacity to provide larger reserves.
- Insulate steam heated dryers.
- Insulate all steam lines that pass through air conditioned areas.
- Use steam generators at point of requirement in lieu of a central steam boiler installation for steady state load situations.
- Generate steam at the point of use, rather than centrally generate and reticulate.

Maintenance Measures

- Maintain insulation on steam lines.

LANDSCAPING

House Keeping Measures

- Use vegetation (deciduous trees, lawn, etc) to minimise reflection towards the building.
- Use landscaping not only for shade but also for wind brakes and to assist with the cooling mode.
- Landscape to provide protection from the east and west sun.
- Keep north vegetation at a height that will not inhibit winter sun penetration.

SECTION VII

DIGITAL MICROPROCESSOR ENERGY MANAGEMENT SYSTEM

SECTION VII : DIGITAL MICROPROCESSOR ENERGY MANAGEMENT SYSTEM

SOFTWARE REQUIREMENTS SCHEDULE

- Provide a real time load profile of the monitored electrical loads (via pulse meters) with immediate access by the operator to present and stored data located on the site computer's hard drive.
- Provide a selectable load profile form stored data to allow a comparison of the present load profile against any selected day in the history of the energy management installation.
- Store load profile (average 30 minute demand periods) and energy usage data of all monitored loads.
- Print, on request, a five minute history load profile graph.
- Provide at least six additional load profiling history graphs for monitoring other large energy using equipment. This facility shall permit the supervision of any one of the six selected loads into the existing load profile.
- Provide the means whereby a load may be programmed into a variety of load control strategies catering for almost any load situation.
- Accept override commands issued by the operator or by a time schedule programmed.
- Include a multi-functional time clock function allowing any field point to be controlled on a minute by minute basis, any hour, any day of the week and any day in the month. The time clock shall have selectable holiday periods, multi-level demand set points throughout the day, capacity to toggle between maximum demand to duty cycle for any point and the ability to change maximum demand and duty cycle parameters for day or night operation and time frames for RESET operation. Time resolution shall be within one minute for time clock control.
- Prevent load cycling from increasing electrical energy demand by preventing synchronisation of cycle load with maximum demand, using target load cycling.
- Provide manual override ability on all points.
- Switch on all background/safety lighting on actuation of fire or security systems.
- Provide for an alarm on maximum demand which is activated when the EMS predicts that the maximum demand set point will be exceeded.

- Display the status of all channels able to be displayed, including the previous command.
- Provide for load shedding in accordance with preset limits with variable cycling and frequency of all load shedding points or loads.
- Provide for all energy management, monitoring, control and data logging functions to remain operative while any normal computer function is being performed in the EMS, including the operation of any software programs.
- Have the ability to be used in multi-tasking for multi-user situations.
- Able to access to all functions via a menu system.
- Provide a minimum of three adjustable operator access levels based on passwords.
- Provide audible alarm annunciation with silencing on acknowledgment and disability of alarm annunciation.
- Able to commence automatic controlled restart on regaining power supply after power failure, to prevent all of the controlled equipment coming on together and causing a high energy use and demand peak.
- Possess the ability to use and interface with graphics.
- Able to offer on-screen action advice on point change of state i.e. auto on, auto off.
- Provide comprehensive energy usage reports and graphs (soft and hard copies).
- Permit all points to be operator selected to print on change of state. The following details are to be logged on the printer: point address, point description, point status, and time and date of change of state for that point.
- Permit recorded and calculated data to be used in the energy saving calculations shall be available for examination by the site operator and/or the remote computer operator. Each appropriate section of data shall be displayed in one or more of the following formats: graphic, tabular or control point history.
- Provide a minimum of 128 channels with a capacity for further expansion as required.
- Incorporate a time display.
- Incorporate a date display.
- Provide target cycling.
- Incorporate alarm monitoring.

- Provide event scheduling.
- Provide holiday scheduling.
- Provide current daily Kwhs.
- Provide current demand history.
- Provide monthly demand history.
- Incorporate operator access levels.
- Provide temperature monitoring.
- Provide day/night duty cycling.
- Provide rotational load shedding.
- Incorporate audible alarm annunciation.
- Provide off continuous load setting.
- Provide night purging of building.
- Incorporate additional feeder pulse inputs.
- Incorporate fifteen or thirty minute billing periods.
- Incorporate pulse input from utility meters.
- Incorporate multi-functional time scheduler.
- Incorporate demand shedding priority settings.
- Incorporate time clock control on all channels.
- Incorporate duty cycle control on all channels.
- Incorporate maximum demand control on all channels.
- Provide manual override control on all channels.
- Provide multiple demand limit set point function.
- Provide automatic controlled restart after power failure.
- Incorporate multiple choice of hardware capability interface.

- Incorporate simultaneous handling of at least two types of control hardware simultaneously.

SYSTEM FUNCTIONS SCHEDULE

- Switching of enable or disable and ON/OFF points based on item schedules and/or light sensitive switches.
- Pulsing ON and OFF of lights based on time schedules and/or light sensitive switches.
- Demand and power usage monitoring and recording. Demand limit control shall not employ floating setpoint strategies.
- Manual switching of AC unit heaters.
- Minimum fault monitoring, alarm functions and displayed advisory messages for selected points, in keeping with the nature of the systems supervision.
- Holiday scheduling.
- Event scheduling.
- Duty cycling.
- Temperature override.
- Outside air optimisation.
- Electrical demand limiting.
- Trend and data logging.
- Auto restart following power failure.
- A computer based graphical display for the visualisation of the system's condition, history and for reprogramming its parameters under secure access.
- End of day close down for all non-security lighting, eg. base level corridor lighting, on operation of a close down pulse-switch key by the night security officer.

OPERATOR TOOLS SCHEDULE

- Load status displayed.
- Programmable sub menus.

- Kilowatt used history.
- User designed graphics.
- Management reports.
- Fully programmable database.
- Real status condition displayed.
- Adjustable Y axis of graphics.
- Real time load profile graph.
- Comparison load profile graph.
- Channel change of state print action.
- Comprehensive energy history records.
- Long-term history of building load profiles.
- Dynamic real time screens showing channel status.
- Comprehensive print out of graphical displays.
- Indication of exceeding comparison graph usage.
- Visual alarm on prediction of exceeding set point.
- Immediate access to current historical information.

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